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Methyl bromide alternatives

Vol. 2, No. 1 January 1996

From the ARS Administrator

We are devoting this issue of the newsletter to selected reports from the Second Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reduction, held November 5-8 in San Diego, California.

The general consensus was that although no big breakthroughs were reported, we are making progress on finding alternatives for methyl bromide. It is universally felt that there is no single method or single combination of chemical and nonchemical methods that is likely to replace methyl bromide and more research is necessary.

A remark made by a grower at one of the late-night discussions during the conference bears repeating. He said he'd be willing to change his practices if only he knew how the change could occur and be implemented without compromising his economic survival. We're working to give him answers.

At the conference, we met with our research customers and partners to discuss plans for a $750,000 increase in funds appropriated by Congress for methyl bromide work in FY 1996. Of this amount, $200,000 will be used to increase our research efforts to capture and recycle methyl bromide for postharvest uses. The rest will go toward establishing projects to field-test preplant methyl bromide alternatives. Thomas Trout, with the ARS lab in Fresno, California, and David Patterson, at Fort Pierce, Florida, will coordinate the field tests with our university and industry partners.

The major thrust will be to validate in the field, on as large a scale as possible, potential alternatives to methyl bromide. We plan to use cultural practices, alternative chemicals, biological control agents, and any viable combination.

Initially in Calfornia, we'll look at strawberries, with perennial and tree crops to follow. We're working with the Strawberry Commission and the University of California, using strawberry fields in the Watsonville area of central California. We'll be looking at 1,3-D (Telone) as a possible chemical alternative and will seek grower cooperation. Since environmental conditions vary, we're also seeking a site in southern California, possibly in the vicinity of Oxnard.

Field sites have not yet been identified in Florida, but we're meeting with our cooperators from industry, the University of Florida, and the Florida Fruit and

Inside This Issue

This newsletter provides information on research for methyl bromide alternatives from USDA, universities, and industry.

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Vegetable Association in January to discuss whether to use growers' fields or experiment station lands. We're also seeking their input on what pests and what fruit and vegetable crops to target.

Lastly, as you may know, the parties to the United Nations' Montreal Protocol on Substances that Deplete the Ozone Layer reached an agreement at their 7th meeting, held in Vienna, Austria, December 5-7, 1995, that will eliminate use of methyl bromide in industrialized countries in 2010. This phaseout date will be preceded by a 25-percent cut in 2001 and a 50-percent cut in 2005. Under the agreement, developing countries will freeze methyl bromide consumption in 2002. These actions will have no bearing on the total phaseout date for the U.S., which is January 1, 2001.

Floyd P. Horn
Administrator
Agricultural Research Service

From EPA

"It is clear that it will take numerous pest control strategies to substitute for the wide array of uses that methyl bromide currently and so effectively covers," stated Daniel M. Barolo, with the U.S. Environmental Protection Agency. Director of EPA's Office of Pesticide Programs, Barolo spoke at the San Diego Conference about the need for all those affected by the loss of methyl bromide to work together.

"Since Congress, by way of the Clean Air Act, has prohibited the production and importation of this multipurpose fumigant after January 1, 2001, it is critical that government, industry, pesticide users, and the agricultural research community work together to advance alternatives."

Barolo stated that the role of EPA's Office of Pesticide Programs is to help by giving priority to evaluating and registering viable alternatives to methyl bromide.

"We are mandated to require and process data to evaluate whether methyl bromide may continue to be used, regardless of activities under the Clean Air Act or the Montreal Protocol," he said. Under amendments to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), all pesticides registered before November 1984 (which includes methyl bromide) must be reviewed for reregistration, and data supporting registration must be brought up to current scientific standards. The pesticide will be suspended and/or canceled if registrants fail to supply necessary data and pay required fees essential for reregistration.

"Methyl bromide is currently being supported for reregistration, although some uses are likely to be dropped," Barolo said. "User groups and registrants are developing required data. The last data required by EPA to reregister methyl bromide are expected to be submitted to us in late 1997."

A decision on whether or not EPA will reregister the compound is expected sometime in the fall of 1998.

"This past July, I signed a pesticide regulation notice formally announcing

EPA's commitment to expedite review of potential methyl bromide alternatives," Barolo said. "In cases where all requirements have been met, we plan to have a decision for registering biological pesticides within 8 months, for new food uses of registered pesticides in 6 months, and for new active ingredients in 12 months."

He mentioned that there are regulatory, information, and economic barriers that may hamper adoption of methyl bromide alternatives. Some countries now specify methyl bromide for quarantine treatment. Also, there is no consensus among our States or with other countries on efficacious chemical or nonchemical alternative substitutes for controlling pests.

One area that Barolo touched on was the cost of alternatives. Cost, he said, may be an important factor in securing acceptance of alternatives, particularly in the developing world.

"It is in our best interest to not only develop potential alternatives, but to work hard at gaining their international acceptance," he said. "We've already received one application to register a product as a potential alternative to methyl bromide as a preplant fumigant. And we've had discussions on the possible registration of a new active ingredient that could be a potential methyl bromide alternative."

Barolo said that EPA is fostering the development of alternatives and also studying ways to reduce risks from methyl bromide emissions. Under FIFRA's Section 18—which covers emergency exemptions—EPA requires that State and Federal pesticide regulatory agencies seeking emergency exemptions for methyl bromide do the following:

* Document the steps taken to find an appropriate alternative
* Include a commitment to pursue work on alternatives

These requirements are essential and will accelerate the development and trial of alternatives.

From APHIS

USDA's Animal and Plant Health Inspection Service is charged with protecting the United States from the introduction and establishment of exotic agricultural pests, Donald Husnik reported at the San Diego Conference. APHIS Deputy Administrator for Plant Protection and Quarantine, Husnik said that the agency's mission is also to facilitate trade in the global marketplace.

Husnik said that the loss of ethylene dibromide (EDB) in the early 1980's heightened the awareness of our increasing dependence on chemical fumigants. And, while the loss of EDB had major repercussions on our quarantine program, it was mitigated somewhat by knowing that we had methyl bromide as an alternative. Since then, he said that APHIS' number one objective has been to find alternative quarantine treatments for both EDB and methyl bromide.

Alternatives developed by the Agricultural Research Service for commodities that had formerly been treated with EDB and could not tolerate methyl bromide include hot water, hot air, and cold treatments. However, these treatments have limitations that include time, cost, and usable temperature ranges.

"We must work together to develop treatment technologies and phytosanitary certification systems," Husnik said. "There is a need for more dialogue among scientists on an international level regarding standards for quarantine security. This will lead to international acceptance of new treatment methods and certification systems."

Without substantial progress on this interaction, the loss of methyl bromide will put U.S. quarantine efforts, and a substantial part of our export trade, in an extremely precarious position.

"Global trade pressures and the impending loss of methyl bromide make it imperative that every practical treatment option be explored as quickly as possible," Husnik stated. "The potential loss of this chemical from the arsenal of risk management options available to plant quarantine officials will undoubtedly have serious negative effects on import and export programs in all countries."

Impacts from the loss of methyl bromide are expected to fall into two categories:

1. A great reduction in the number and range of treatments that can be prescribed in advance as the basis for authorizing the import and export of regulated materials. This will result in increased emphasis on the pest risk analysis process to more precisely estimate risks, thereby reducing the number of minor phytosanitary concerns.

2. A serious reduction in the number and range of treatment options available for emergency action programs based on the detection of a pest. This affects the ability to prescribe commodity treatments resulting from inspection at ports of entry. It also limits the options available for emergency treatments applied for commodities moving domestically.

Husnik said that the most serious threat to trade will be the reduction in number and range of treatments available for emergency action programs because of the importance currently placed on methyl bromide as an emergency treatment. No other treatment offers the same degree of flexibility, economy, portability, and range of applications for emergency actions.

APHIS has placed greater emphasis and resources on exploring usable alternatives to methyl bromide.

"We 're aggressively developing a policy and operation procedures on irradiation that establish linkage between the technology and phytosanitary problems," Husnik reported. "We're also updating the 1989 regulation that adopted irradiation as a phytosanitary treatment to move papayas from Hawaii to the U.S. mainland. The proposal is to allow treatment in approved areas of the mainland and to adopt the newly proposed generic dose of irradiation for fruit flies of concern."

Other changes that Husnik envisions with the loss of methyl bromide include:

* Scrutinizing more carefully the tolerable level of risk for pests.

* Redesigning programs with shift toward pre-clearance and inspection processes with tolerances.

* Increasing use of mitigation systems to achieve quarantine security without treatment or by combining partially effective treatments with other mitigation measures.

* Relying more heavily on overseas certification, field surveillance, host/nonhost status, and other risk management techniques traditionally more difficult to accept or develop.

* Redefining quarantine security more precisely and avoiding gross judgments simply because a convenient treatment is available.

Irradiation as a Postharvest Treatment

Irradiation—Quality Issues

Blueberries are plagued by quarantine pests including the blueberry maggot, apple maggot, and plum curculio. Currently, methyl bromide is the only approved treatment that will allow blueberries to be shipped to places that don't have these pests, like California, Ontario, and British Columbia. ARS scientists at Miami and Orlando, Florida, have shown that irradiation should control these pests without affecting the quality of the blueberries.

"Most fruits and vegetables will tolerate ionizing radiation at low doses with minimal detrimental effects on quality, making irradiation a potential quarantine treatment," ARS horticulturist Roy E. McDonald stated at the San Diego Conference on Methyl Bromide, Nov. 5-8, 1995. "It is essential that a quarantine treatment be effective and efficient without harming the commodity's quality."

McDonald and colleague William R. Miller, with the U.S. Horticultural Research Laboratory in Orlando, Florida, have studied the issue of how gamma radiation affects fruits and vegetables—their quality, condition, and susceptibility to decay.

"Some commodities can be damaged at radiation doses between 0.25 and 1.0 kilogray," McDonald said. "Generally, nonfruit vegetables like lettuce are much more sensitive to irradiation stress than fruits like apples or fruit-vegetables like tomatoes."

When gamma radiation was proposed as a potential quarantine treatment for fruits in 1956, ARS scientists in Hawaii investigated its effects on fruit flies in papayas and other tropical fruits. McDonald said that though most of the research since then has dealt with insect mortality, some studies have evaluated the effect of irradiation on fruit quality.

"If the quarantine treatment reduces the value of the commodity, then that treatment is not fully effective," he said. "Any adverse change in shelf life, appearance, flavor, texture, aroma, or susceptibility to decay organisms constitutes damage, because these factors determine marketability."

Preharvest factors like climate and cultural practices may influence a commodity's response to irradiation stress, he reported. The way radiation

is administered can also affect the response.

In some crops—like blueberries—irradiation is the only apparent alternative to methyl bromide because other fumigants, and physical treatments like heat or cold, are not viable treatments.

Blueberries tolerate irradiation without adverse effects. However, the effects of irradiation have not been studied for insect disinfestation for many other crops. McDonald suggested several areas of future research on how irradiation affects the quality of horticultural commodities:

1. Identify preharvest or postharvest treatments that reduce possible damage.

   Improved horticultural practices—irrigation, hormonal sprays, fertilization, increasing calcium uptake—may increase resistance to irradiation stress. Maturity of the commodity at harvest, time between harvest and treatment, and post-treatment storage conditions also need to be considered.

2. Determine the physiological basis for conditioning.

   The conditioning phenomenon, a pretreatment process that has been found to reduce damage from heat and cold treatments, could alleviate some irradiation damage. The physiological and biochemical basis of irradiation damage needs to be determined.

3. Develop objective methods to measure irradiation damage.

   Objective methods are needed to provide uniformity in assessing quality and damage. These methods would provide quantifiable information that could be related to biochemical indices. These indices could indicate thresholds of damage or predict potential damage, allowing greater flexibility in developing irradiation quarantine treatments.

Irradiation—California's Perspective

The loss of methyl bromide for agricultural uses will hurt California's import and export trade, according to David Luscher. "It is vital that we identify, evaluate, and develop all possible alternative quarantine treatments," Luscher said at the San Diego conference. "We are currently looking at how we might integrate irradiation treatment into our current plant quarantine program. When supplemented with additional controls, irradiation is an excellent potential alternative treatment to methyl bromide."

An associate agricultural biologist with the Pest Exclusion Branch of the California Department of Food and Agriculture (CDFA), Luscher said there are apparently no regulatory issues that would restrict use of irradiation on food or hinder the sale of treated products in California. He also said that CDFA supports the work of USDA and the Hawaii Department of Agriculture to irradiate Hawaiian fruits regulated under Federal quarantine.

"I understand that the success of this work will provide justification to erect a commercial irradiation facility in Hawaii," he said. "We have also been cooperating with the ARS Miami laboratory to irradiate papayas, sweetpotatoes, blueberries, and longans."

Luscher said that CDFA's concern with using irradiation as a quarantine treatment is how to address irradiated pests that are still alive on treated commodities that enter California.

"Unlike methyl bromide, irradiation targets reproductive and developmental abilities of a pest, often without killing it. Currently, there is no quick, reliable field test to determine whether or not live pests have been irradiated."

But the CDFA does not think this is an insurmountable obstacle. Luscher said that the irradiation treatment could be supplemented with pretreatment inspection actions that begin in the field and continue through harvest, processing, and treatment. And even though no one action would eliminate pests, the cumulative result should reduce the probability of live pest infestation on arrival in California to an acceptable level.

"What we need is agreement among USDA, our trading partner States, and industry as to what an acceptable confidence level will be on irradiated commodities. Also, we all need to decide on what actions will be taken if a live quarantine pest is found on a treated shipment," Luscher added.

According to Luscher, the Jamaican papaya industry and the Florida sweetpotato, blueberry, and longan industries have asked CDFA to allow irradiation to fulfill quarantine requirements for their produce to enter California.

Irradication—Continued

"We're investigating the possibility of allowing commercial shipments of specific irradiated commodities to enter California under special permit," he said. "Jennifer Sharp, research leader at the ARS Subtropical Horticulture Research Station in Miami, has been helping us develop and generate treatment data on these commodities to support this effort."

As a result of this work, papayas grown in Jamaica and irradiated by the Food Technology Service in Florida to eliminate the Caribbean fruit fly, were shipped into California as a one-time entry for the Produce Marketing Association Exposition in October 1995.

Luscher said that, currently, fresh blueberries from areas regulated for the blueberry maggot and plum curculio cannot enter California without methyl bromide fumigation. Although Florida-produced commercial longans aren't regulated under any California plant quarantine, they're often rejected because of infestation by species of scales and mealybugs, which are quarantine pests. Sharp is working with CDFA and with the Florida longan and blueberry industries on an appropriate irradiation treatment for these crops.

Florida-grown sweetpotatoes are prohibited from California markets because of the sweetpotato weevil. Since sweetpotatoes can't tolerate fumigation with methyl bromide, Sharp is working with the Florida Department of Agriculture and Consumer Services to establish data on an irradiation treatment that CDFA will accept, hopefully opening a new market for Florida growers and California consumers.

Luscher contacted three of California's largest fresh fruit industry groups to get their reaction to using irradiation as an acceptable quarantine treatment.

"I found industry supportive of irradiation as a quarantine treatment," he said. "In fact, they would like to see similar efforts to develop irradiation quarantine treatments so that California commodities can continue to be exported should methyl bromide use be restricted or lost."

Irradiation—Hawaii's Perspective

Hawaii is the only State under Federal fruit fly quarantine. By prohibiting shipment to the U.S. mainland of Hawaii-grown fresh fruits and vegetables that are fruit fly hosts, this quarantine—which protects the mainland—has stifled expansion of diversified agriculture in Hawaii for over 50 years.

But there is now an approved quarantine treatment, said Lyle Wong, who is with the Plant Industry Division of Hawaii's Department of Agriculture. It's gamma irradiation, which is safe and effective without harming taste and quality of many tropical fruits.

"Irradiation for fruit fly has been approved by USDA since 1989 as a quarantine treatment for papaya grown in Hawaii, but has not been implemented because we don't have a commercial food irradiator," Wong said. He spoke at the Conference on Methyl Bromide in San Diego.

"But this treatment offers us an opportunity to expand tropical fruit production in Hawaii. This industry is in its infancy, but the feeling is that its expansion could be worth millions of dollars of new revenue for Hawaii."

According to Wong, the Hawaii Department of Agriculture has an ongoing project to evaluate the feasibility of irradiating papaya, lychee, atemoya, rambutan, star fruit, and other exotic tropical fruits now in commercial production in Hawaii.

"Trial shipments of these fruits have been irradiated by Isomedix in Morton Grove, Illinois, and have been sold in Chicago, Indiana, and Ohio," he said. "Consumer acceptance has been excellent."

USDA's Animal and Plant Health Inspection Service is proposing to change the existing rule on papaya to allow irradiation of papaya and other fruit in Hawaii as well as on the mainland. APHIS will also propose to establish a generic treatment dose for commodities that may be hosts of specific fruit flies.

"This will allow Hawaii to move any fruit and vegetable for which only fruit flies were determined to be a pest concern, to the mainland United States for retail sale after radiation treatment in Hawaii or at destination," Wong stated.

The closing of large sugar and pineapple plantations in Hawaii is making thousands of acres of prime agricultural lands available for planting tropical fruits and vegetables. Also, irradiation is a commodity treatment that can go online now.

"Getting our irradiated fruit to U.S. mainland markets has been a cooperative effort between our people here in the Hawaii Department of

Agriculture and with industry, ARS, and APHIS," Wong said. "It is our objective to have a treatment facility in Hawaii, probably on the Island of Oahu, which would serve agriculture statewide. Irradiating fruit here, before export, opens new U.S. as well as foreign markets for our growers."

Technical Reports

SoilGard™ for Soilborne Disease Control

R.D. Lumsden, Research Leader, Supervisory Plant Pathologist, J.A. Lewis, Research Soil Scientist, and D.R. Fravel, Research Plant Pathologist, Biocontrol of Plant Diseases Laboratory; and J.C. Locke, Florist and Nursery Crops Research Unit, USDA, ARS, Beltsville, MD 20705.

Scientists at the USDA, ARS, Beltsville Agricultural Research Center have responded to the need to identify and develop alternative strategies for soil fumigation, which has been done traditionally with methyl bromide, by directing several research programs to address this critical problem. A total of six permanent scientists (SY's), along with their support personnel, are currently involved in this effort. These SY's represent several disciplines: plant pathology, soil science, microbiology and nematology, providing a range of expertise related to the control of soilborne plant pathogens.

Soilborne diseases caused by pathogens such as *Pythium* and *Rhizoctonia* are constant problems in the horticultural industry and require the use of chemical fungicides, including methyl bromide. For decades, researchers and growers throughout the world have noted that while some soils tend to encourage soilborne diseases, other soils tend to suppress these same diseases. Years of research have indicated that beneficial soil microorganisms such as *Gliocladium virens* are responsible for this disease suppression. Yet, until now, problems with formulation inconsistency and application have prevented the commercial application of many biological organisms to control plant pathogens.

SoilGard™ is a technological breakthrough and captures the pathogen suppressiveness of the fungus *Gliocladium virens* GL-21 in a convenient, stable and highly effective form. Developed in collaboration with Grace Biopesticides and the Biocontrol of Plant Diseases Laboratory of USDA, ARS in Beltsville, Maryland, SoilGard™ is an entirely natural product consisting of spores of the fungal strain GL-21 in a granular formulation. SoilGard™ is registered with the U.S. EPA for control of damping-off and root rot pathogens of ornamental and food crop plants growing in greenhouses, nurseries and interior gardens. The label will be expanded for use in the field. Although SoilGard™ was first found to have activity against damping-off caused by *Rhizoctonia solani* and *Pythium* species, it has recently been found to protect row crops from *Sclerotium rolfsii* and possibly other host-pathogen combinations.

When incorporated into potting media, SoilGard™ controls plant pathogens through a variety of mechanisms including parasitism, antibiosis, competition and exclusion. *Gliocladium virens* is known to parasitize some soil pathogens such as *R. solani*. The *Gliocladium* will actually wrap itself around the pathogen and release enzymes that destroy the pathogen's cuticle, leaving the pathogens susceptible to attack. GL-21 also produces a broad spectrum antibiotic called gliotoxin which kills many soil pathogens. Gliotoxin is not found in the SoilGard™ formulations, but when the spores of GL-21 begin to grow in the soil, GL-21 produces the antibiotic.

SoilGard™ represents the new generation of environmentally friendly pesticides. SoilGard™ has a "Caution" label, but the product has essentially no mammalian toxicity. It is exempt from tolerance for use on all food crops. SoilGard™ has the minimum re-entry interval allowed by the U.S. EPA and has a "zero day" preharvest interval.

The team at Beltsville is carrying out studies to expand the use of SoilGard™ to determine its effectiveness in integrated pest management (IPM) and sustainable systems for replacement of methyl bromide. If successful, this product may be used immediately in applications where methyl bromide has been used routinely for control of soilborne disease problems. The team has identified several additional beneficial microorganisms for control of soilborne plant pathogens. Some of these microorganisms have been recently discovered, while others are near transfer to industry for development as commercial products.

Technical Reports—Continued

Reduction of Fusarium Crown and Root Rot of Tomato by Combining Soil Solarization and Metam Sodium

R.J. McGovern, Associate Professor, Plant Pathology, Gulf Coast Research and Education Center, Bradenton, FL 34203; and C.S. Vavrina, Associate Professor, Horticultural Sciences, T.A. Obreza, Associate Professor, Soil and Water Sciences and J.C. Capece, Assistant Professor, Agricultural Engineering, University of Florida-IFAS, Southwest Florida Research and Education Center, Immokalee, FL 33934.

Over the past 5 years, Fusarium crown and root rot [*Fusarium oxysporum* f.sp. *radicis- lycopersici (FORL)*] has been the most prevalent soilborne disease of tomato in southwest Florida. However, crown rot severity varies widely by site and season and is favored by cool temperatures. Methyl bromide combined with chloropicrin has provided effective control of crown rot and other soilborne pests of tomato. Nevertheless, classification of methyl bromide as an ozone depleter and its impending removal by the year 2001 dictate the development of alternative management strategies for crown rot.

We previously conducted a series of field experiments which suggested that metam sodium could reduce Fusarium crown rot only when thoroughly incorporated in the planting bed, such as through application to the soil prior to bed formation. We also showed that heating the soil by mulching with clear plastic (soil solarization) could reduce FORL populations in the upper 5 cm of soil. Other researchers have amended soil with compost to decrease disease and increase yields. Recently, we conducted an experiment to evaluate the use of soil solarization alone and in combination with metam sodium or composted sewage sludge for crown rot reduction.

A commercial tomato field in southwest Florida, naturally infested with FORL was used to compare the effectiveness of methyl bromide:chloropicrin, 67%:33% (Terr-O-Gas 67, 336 kg/ha), metam sodium (Vapam, 935 l/ha), composted sewage sludge (Florida Organix, 5.5 MT/ha), soil solarization and combinations of solarization and Vapam or Florida Organix in reducing Fusarium crown rot. The field was thoroughly wetted and cultivated prior to the start of the experiment on 30 Aug, 1994. Florida Organix was applied to the soil surface before bed formation. Vapam was sprayed on a preformed bed and rotovated to a depth of approximately 23 cm, followed by final bed formation. Terr-O-Gas was injected approximately 23 cm deep at bed formation.

All nonsolarized beds were covered with 1.5 mil, white polyethylene mulch following fumigant and compost application. Soil was solarized by covering beds with 1.5 mil, clear polyethylene mulch which was painted white after 6 weeks using Kool Grow (Kool Grow, P.O. Box 2278, Gainesville, FL, 32602). Soil temperatures were recorded during the solarization period at depths of 5, 15 and 23 cm in plots covered with clear or white mulch and in nonmulched soil using a datalogger (Campbell Scientific, CR-10). A randomized complete block (30.5 m x 81 cm bed) design with six replicates was used. Transplants of the tomato cv. Agriset were planted using a 46 cm in-row spacing on 10 Oct. The marketable fruit from 32 randomly selected plants per block were harvested twice (4 and 23 Jan, 1995) and then uprooted for crown rot evaluation.

Fusarium crown rot incidence was high, and severity (% crown discoloration) low throughout the field. Crown rot incidence was significantly reduced by Vapam (-29%), solarization plus Vapam (-51%) and by Terr-O-Gas (-50%), while disease severity was significantly reduced (-74%) by both the latter two treatments. No significant differences in marketable yield were observed among the treatments. It is not surprising that solarization alone failed to decrease crown rot, since the treatment period was unusually rainy, and soil temperatures which cause the rapid death of FORL (50-60 degrees C) were not reached even at a depth of 5 cm. (Cumulative rainfall for September was 51% higher than the 30-year average recorded at SWFREC, Immokalee).

Lack of significant yield increases over the control by any of the treatments may be attributed to low disease severity resultant from milder than normal temperatures during the experiment. (Mean air temperatures during October, November and December were 0.5, 1.9 and 1.7 degrees C higher, respectively, than the 30-year means for those months). Reduction of Fusarium crown rot by solarization combined with metam sodium equivalent to that achieved by methyl bromide plus chloropicrin is noteworthy and merits further research.

USDA Perspective on Methyl Bromide Second Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reduction

Floyd P. Horn, Administrator
Agricultural Research Service, USDA
Formerly, Deputy Under Secretary of Agriculture, REE

Good morning. It is an honor to be invited to speak to you on a topic of great importance to U.S. agriculture. I want to express my appreciation to the Crop Protection Coalition (CPC) for organizing this important conference. I am pleased that the USDA can again this year be a co-sponsor with the CPC and the Environmental Protection Agency.

During my 10-month tenure as Deputy Under Secretary for Research, Education and Economics, I had the opportunity to meet with affected industries in California and Florida and to discuss, first-hand, the impact that the loss of methyl bromide (MB) could have on large segments of the agriculture industry. But this is not just a problem restricted to these two States. MB is used all over this country. I will mention a few of the uses to illustrate the complexity of finding alternatives, be they other pesticides, other types of technology or procedures, or combinations thereof. These examples will make it clear that there will be no one single solution to replacing MB. First, let us consider preplant soil fumigation.

Vegetables
The 24,000-acre strawberry industry in California produces fruit from the end of January to November. This, plus the 5,000-acre industry in Florida, which produces fruit from late November to March, provides a year-round supply of strawberries for the United States. Virtually all of this acreage is fumigated with MB, or mixtures of other fumigants and MB, before planting each year. The current MB-based production system has seen yields increase 5-to-10 fold over the last 30 to 40 years. Maintaining these yields is possible only if these plants can be kept free of soilborne diseases and pests. Results from field trials done during the last 3 years show that there will be an estimated loss of 35% to 45% during the first year without the use of MB. In addition, there will be a breakdown of the IPM-based cultural system that depends on a healthy, vigorous root system. This will result in increased use of water, fertilizer, and other pesticides to control pests attacking plants weakened by a poor root system.

Not as obvious, but probably more important than MB use in strawberry production fields, is its use by the strawberry nursery industry. Several years are required for a nursery to produce enough plants of a new variety for transplant to production fields. It is essential that these plants be kept free of soilborne diseases during this time. Soil fumigation with MB is currently the only way to do this.

The Florida winter vegetable production industry relies heavily on MB to produce tomatoes, peppers, eggplant, and strawberries. For these crops, MB now controls soil pathogens, nematodes and weeds, particularly nutsedge. It is estimated that without MB, yields would decrease by up to 30%. Vegetable production in Florida currently faces extreme competition from the Mexican vegetable industry with its ready access to a cheap labor force. MB is an important tool for Florida growers to compensate for differences in labor costs between the U.S. and Mexico. In fact, University of Florida economists recently predicted that the MB ban will result in the loss of much of the Florida winter vegetable industry to Mexico if practical, economically viable alternatives are not found. Complicating the search for alternatives in Florida is the high water table which limits pesticide options because of the possibility of water contamination.

Deep Rooted Plants
Another important use of MB is in the production of tree seedlings for reforestation. Seedlings are transplanted into a generally inhospitable environment where good seedling vigor is essential to survival. Experience has shown that seedlings grown on non-MB treated soil experience high mortality when transplanted due to plant pathogens contracted in tree nurseries.

Likewise, in the fruit and nut production industry, if diseased trees or orchards are replaced, good orchard practice dictates fumigation of the soil with MB to prevent reinfection of the new trees by the same soilborne pathogens.

MB is the only effective treatment for oak wilt, a disease which is fatal to almond trees. Spores of the oak wilt fungus can live in the soil for decades. Therefore, before almond trees can be planted in areas where oak trees have grown, the soil must be treated with MB.

Similarly, before replanting grape vineyards, soil often is fumigated with MB to kill diseased grape roots remaining in the soil from the previous vineyard. These old roots can live for several years after the tops have been removed, may be located several feet beneath the soil surface and serve to infect newly planted vines by grafting to the new grape roots.

Postharvest
Methyl bromide is also critical for postharvest fumigation. Banning ethylene dibromide in the mid-80's left U.S. agriculture with two postharvest fumigants: phosphine and MB. Phosphine is primarily used to fumigate grain and some durable commodities such as nuts and dried fruit. MB is the only U.S. registered fumigant with wide applicability for fresh commodities. Fast acting (typically 2 to 4 hours), it causes little or no damage to most commodities, is very toxic to insects or other arthropod pests and can kill pests located inside the fruit. MB is used to disinfest imported commodities and preserve quality during storage. At ports of entry, plant quarantine officials use it to disinfest commodities found to be infested with quarantined pests. The United States, and many of our most important trading partners, require MB treatment as an absolute condition before importing

many commodities from areas of the world that have particularly dangerous pests.

It is the only emergency fumigant to allow movement of susceptible commodities from a quarantined area because of an introduced pest. Mediterranean fruit flies (MFF) and other pests have frequently been accidently introduced into the U.S. These introductions have resulted in quarantines to prevent spread of the pest while eradication efforts were underway. If MFF, which can infest over 200 commodities, were to invade the San Joaquin Valley or the vegetable production area of Florida, movement out of the quarantined area of scores of commodities would be forbidden unless they were fumigated with MB. Absence of an emergency fumigant for fresh commodities is an invitation to disaster. Past history assures us that quarantines will occur and emergency treatments will periodically be needed.

There are many examples where MB is critical to movement of commodities in international trade. Finding MB alternatives for some of these uses may be the most difficult task of all. Recognizing this, the framers of the Montreal Protocol exempted quarantine uses from regulation. The following three examples illustrate commodity quarantine uses.

About a year and a half ago, the U.S. gained Japanese approval for a quarantine treatment that allows apples from Washington State to be sent to Japan. The first apples were actually shipped late last year. The quarantine pests of concern are two insect pests, codling moth and lesser apple worm, and fire blight, a bacterial disease. The combination treatment that Japan approved requires methyl bromide fumigation. The United States has tried to ship apples to Japan for over 2 decades. An ARS scientist at our Yakima, Washington, laboratory has worked on this issue intermittently for his entire 30-year career. This illustrates the point that quarantine issues usually take years and sometimes decades to resolve. I don't need to remind you that we only have a few years to find and develop alternatives and have them approved by the importing country.

Oak logs from the Appalachian region must be MB fumigated before export to Europe to kill the oak wilt organism. This is the same disease organism that I referred to earlier when I talked about almond plantings. This is a very important market for the United States, but is one of the largest postharvest users of MB.

Grapes and stone fruit from Chile are examples of the many imports which would be impacted by an MB ban. Chile is the main source of winter grapes and stone fruit for the United States. Some 40 million, 40-pound boxes of grapes enter the United States from Chile each year. The U.S. requires that all be fumigated with MB to keep out a serious mite pest. Several million boxes of stone fruit from Chile are fumigated as well. There is presently no other effective treatment against this pest that guarantees exclusion from the United States.

The foregoing examples serve to point out the scope and complexity of the problem. Although there is international activity to find replacements for MB, the U.S. has undertaken the largest research effort. The reason for this may stem from the provisions of the U.S. Clean Air Act, which imposes more severe MB restrictions on U.S. agriculture than the Montreal Protocol imposes on other countries.

We at USDA have made developing MB alternatives one of our highest research priorities. At the outset of the MB crisis in 1992, there were no research projects in the Agricultural Research Service (ARS), the USDA's in-house research organization, specifically focused on replacing MB. However, many projects in preplant soil and postharvest research were focused on finding alternatives to pesticides in general. An inventory of these projects indicated that about $7.1 million in base research was applicable to MB replacement. Congress approved a budget increase in FY 1994 of $1 million for additional MB alternatives research, and ARS redirected $5 million more in base funding in FY 1995. The FY 1996 ARS budget of $13.85 million includes a $750,000 appropriation increase. In addition, in the last 3 years, ARS has provided about $750,000 to university scientists for cooperative MB research. The 38 presentations that will be made at this meeting by ARS scientists as well as papers by State cooperators working with partial ARS funding demonstrate that the research investment is paying off.

I also want to emphasize my personal commitment to working with industry organizations such as the CPC to ensure that ARS research is targeted at solving real industry problems and that our scientists are pursuing research approaches that are likely to contribute to those solutions. We believe that a cooperative relationship involving ARS, university, and industry scientists will result in a synergism that leverages everyone's research efforts.

A wide range of approaches is being investigated to replace MB for soil fumigation. This is evident from the titles of research presentations in your meeting program. I think it is clear that scientists believe that for most MB uses, no one approach is likely to satisfactorily replace MB. A combination of approaches packaged into a "system" will be necessary. To facilitate the integration of approaches for soil uses, ARS will fund at a rate of $550,000 per year, field scale validation tests and related research in Florida and California. A senior ARS scientist has been designated in each State to manage and coordinate this undertaking. ARS program leaders met yesterday with representatives of impacted commodities and State and Federal scientists to discuss details of this undertaking. This is a large effort that will require considerable cooperation between the public and private sectors, but it is a crucial step in implementing alternatives to MB. The demonstration of efficacy and practicality on a field scale is vital if we expect growers to adopt new cropping strategies.

Other USDA agencies have also responded to the MB crisis. The USDA Forest Service (FS) has re-established nursery research programs at Athens, Georgia, and St. Paul, Minnesota. At both locations, FS scientists together with university, State and other Federal cooperators, are finding new ways and improving old

ways to deal with pests in forest tree nurseries. The goal is to develop integrated pest management programs that will ensure high quality seedlings. In the postharvest arena, the Forest Service, in conjunction with Foreign Agricultural Service and the Animal and Plant Health Inspection Service, has been successful in negotiations to get U.S. heat-treated coniferous wood accepted into Europe and kiln-dried lumber into Korea in lieu of fumigation with MB.

The Cooperative State Research, Education, and Extension Service, which administers the National Research Initiative (NRI) Competitive Grants Program, has funded research on biological control of soilborne disease organisms for several years. University or Government research with the potential to provide alternatives or reduce the dependency of U.S. agricultural industries on MB is eligible for support in at least nine of its 31 programs. Combined, these programs represent $31.5 million or about 30% of the funds available to the NRI.

In 1993, the USDA's National Agricultural Pesticide Impact Assessment Program conducted an important economic assessment on the short-term impact of a methyl bromide ban on U.S. agriculture. Subsequently, this program has funded more detailed studies by economists in Florida and California on long-term effects of such an MB ban. I referred to the results of the Florida study in my earlier comments on Florida winter vegetable production.

I will close by mentioning a few recent MB-related initiatives at the USDA.

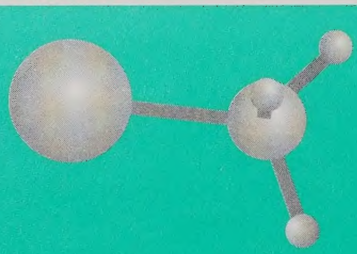
In an effort to leverage scarce monetary resources, the USDA has proposed a cooperative MB research project with Israel through the U.S./Israel Bilateral Commission. Israel is facing some of the same MB issues as the U.S. and has expressed an interest in cooperative research.

In an effort to improve coordination and communication among all concerned, the USDA appointed a USDA Departmental MB Coordinator and established a quarterly newsletter. Copies of the first issue are available here today.

Finally, the USDA National Agricultural Library, in conjunction with ARS and the CPC, is exploring a computerized database on MB to keep scientists and agricultural interests better informed about the current state of domestic and international research directed toward MB alternatives.

As I look across this audience this morning, I see representatives from all aspects of American agriculture. Again, we welcome you. We also welcome the many participants from other countries. We're here because the MB issue affects us all. As I have said before, if we're to find practical and effective alternatives for MB, we must do it together.

Thank you.



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